

We Claim:

1. A liquid filtering apparatus comprising:
  - a washbox;
  - an airlifting tube, extending from the washbox, comprising:
    - an expulsion end within the washbox; and
    - an intake at a lower end opposite from the washbox;
  - a central pipe extending along an outside surface of the airlifting tube from a position just below the washbox to a position just above the intake end;
  - an effluent riser pipe extending along an outside surface of the central pipe from a position just below the washbox to a position above the intake end;
  - an effluent chamber defined by the outer surface of the central pipe, a bottom plate of the effluent riser pipe, an upper plate of the effluent riser pipe, and an inner surface of the effluent riser pipe;
  - at least one screen cartridge in communication with a lower portion of the effluent chamber, the screen cartridge oriented in a generally angular downward direction;
  - a reject outlet pipe communicating the washbox with a reject box; and
  - an effluent collector communicating the effluent chamber with a location outside of the liquid filtering apparatus.
2. The liquid filtering apparatus according to claim 1, wherein the liquid filtering apparatus is placed in a vessel having a bed of filtration material and an intake for introducing unfiltered liquid into an upper region of the vessel.
3. The liquid filtering apparatus according to claim 2, wherein the filtration material is selected from the group consisting of sand, anthracite, ceramic beads and granular activated carbon.
4. The liquid filtering apparatus of claim 2, wherein the liquid is water or wastewater.
5. The liquid filtering apparatus of claim 1, wherein the intake at the lower end of the airlifting tube is a hollow bell-bottom shape.

6. The liquid filtering apparatus of claim 1, wherein the washbox comprises a filter media shield hood attached to an upper portion of the washbox, above the expulsion end of the airlifting tube, a washbox skirt below the filter media shield hood, a washbox isolator at the bottom of the washbox skirt, and at least one inlet tube at a bottom portion of the washbox skirt.

7. The liquid filtering apparatus of claim 6, wherein the washbox further comprises a target plate below the filter media shield hood and above the washbox skirt.

8. The liquid filtering apparatus of claim 6, wherein the filter media shield hood is an airlift return cap.

9. The liquid filtering apparatus of claim 6, wherein the washbox further comprises a porous separation cone below the filter media shield, a dirtied liquid reject collection tray below the separation cone, and a second reject outlet pipe communicating the dirtied liquid reject collection tray with the reject box.

10. The liquid filtering apparatus of claim 1, wherein the reject outlet pipe includes at least one valve.

11. The liquid filtering apparatus of claim 1, wherein the effluent collector includes at least one valve.

12. The liquid filtering apparatus of claim 1, wherein the reject box comprises a weir volume space defined by a bottom side, a riser side and a weir plate, an outlet side comprising an outlet, and a vertical pipe communicating with the weir volume space by way of a riser outlet.

13. The liquid filtering apparatus of claim 12, wherein the height of the weir plate may be adjusted to vary the volume of the weir volume space.

14. The liquid filtering apparatus of claim 13, wherein the weir plate comprises a V-shaped notch along a top side of the weir plate.

15. The liquid filtering apparatus of claim 2, wherein the effluent collector is positioned above the vessel.

16. The liquid filtering apparatus of claim 1, wherein the airlifting tube is disposed in a generally centered position within the central pipe by way of one or more internal guide vanes.

17. The liquid filtering apparatus of claim 2, wherein the vessel is an existing basin with no installed piping, the liquid filtering apparatus is retrofitted to the existing basin, and no holes are cored into the existing basin.

18. The liquid filtering apparatus of claim 1, wherein the screen cartridge is fluidly connected to the effluent chamber by way of a cartridge connector.

19. The liquid filtering apparatus of claim 1, wherein the screen cartridge forms an angle with the effluent riser pipe.

20. The liquid filtering apparatus of claim 19, wherein the angle is less than 90°.

21. The liquid filtering apparatus of claim 2, wherein the depth of the filtration material above the screen cartridge is at least 40 inches (102 cm).

22. The liquid filtering apparatus of claim 1, further comprising a sand cone attached to the bottom plate of the effluent riser pipe and terminating above the intake end of the airlifting tube, the sand cone having a sand cone space defined by the bottom plate of the effluent riser pipe, an inner surface of the sand cone, a sand cone bottom plate, and the outer surface of the central pipe.

23. The liquid filtering apparatus of claim 22, further comprising silt tubes connecting a bottom portion of the at least one screen cartridge to the sand cone space.

24. The liquid filtering apparatus of claim 22, further comprising a sand cone flush tube extending from the sand cone space to an area above the effluent collector.

25. The liquid filtering apparatus of claim 11, further comprising a back flush pipe extending from the effluent collector at a point between the effluent chamber and the valve to a point above the washbox skirt.

26. The liquid filtering apparatus of claim 11, wherein said at least one valve is a telescoping valve.

27. The liquid filtering apparatus of claim 1, wherein the effluent collector is connected to an effluent header.

28. The liquid filtering apparatus of claim 12, further comprising a pipe extending from the outlet of the reject box to a reject manifold.

29. A method of filtering liquid and continuously cleaning an associated filter bed comprising:

- (a) placing a liquid filtering apparatus in a vessel having a bed of filtration material and introducing unfiltered liquid into an upper region of the vessel;
- (b) filtering the unfiltered liquid through the bed in a downward direction;
- (c) collecting filtered liquid in at least one screen cartridge, and conveying the filtered liquid upward into an effluent chamber;
- (d) removing the filtered liquid from the effluent chamber by way of an effluent collector;
- (e) withdrawing a mixture of filtered liquid and dirtied filtration material from a lower portion of the bed of filtration material by way of an airlifting tube;
- (f) washing the dirtied filtration material by deflecting the mixture off of a surface and separating the dirt from the filtration material;
- (g) collecting the dirt and liquid separated in step (f) and removing it by way of a reject line; and

(h) depositing the washed filtration material to the top of the bed of filtration material.

30. The method of claim 29, wherein the filtration material is selected from the group consisting of sand, anthracite, ceramic beads, and granular activated carbon.

31. The method of claim 29, wherein the liquid is water or wastewater.

32. The method of claim 29, wherein the filtration material is washed in a countercurrent manner with unfiltered liquid in step (f).

33. The method of claim 32, wherein the unfiltered liquid is introduced in a swirling flow pattern in step (f).

34. The method of claim 29, wherein the dirt, liquid, and filtration material drop onto an inclined porous surface and the dirt and liquid pass through the surface with the filtration material passing along the surface and dropping into the bed of filtration material, the dirt and liquid being removed by way of the reject line.

35. The method of claim 29, including the step of controlling the rate of flow through the reject line by way of a valve.

36. The method of claim 29, including the step of controlling the rate of flow through the effluent collector by way of a telescoping valve.

37. The method of claim 29, wherein the reject line delivers dirt and liquid to a weir volume space in a reject box, the volume of dirt and liquid in the reject box being controlled by the height of a weir plate, with the dirt and liquid flowing over the weir plate and exiting the reject box by way of an outlet.

38. The method of claim 37, wherein height of the weir plate may be adjusted to vary the volume of the weir volume space.

39. The method of claim 29, wherein the vessel is an existing basin with no installed piping, the liquid filtering apparatus is retrofitted to the existing basin, and no holes are cored into the existing basin.

40. The method of claim 29, wherein the screen cartridge forms an angle with the effluent chamber.

41. The method of claim 40, wherein the angle is less than 90°.

42. The method of claim 29, wherein the depth of the filtration material above the screen cartridge is at least 40 inches (102 cm).

43. The method of claim 29, wherein the liquid filtering apparatus further comprises silt tubes connecting a bottom portion of the at least one screen cartridge to a sand cone space.

44. The method of claim 43, wherein the liquid filtering apparatus further comprises a sand cone flush tube extending from the sand cone space to an area above the effluent collector.

45. The method of claim 44, wherein silt, which is present in the unfiltered liquid, is captured in the screen cartridge, and travels through the silt tubes to the sand cone space, and the silt is removed from the sand cone space by administering liquid or an air/liquid mixture into the sand cone space by way of the sand cone flush tube, forcing the silt out of the sand cone space.

46. The method of claim 29, wherein the screen cartridge is cleared of obstructions by closing a valve on the effluent collector and applying one of air, high pressure liquid, and a mixture thereof through a back flush pipe such that it travels through the effluent chamber and out of the screen cartridge.

47. A liquid filter assembly comprising two or more of the liquid filtering apparatus of claim 1, wherein a reject outlet pipe extends from the outlet of each of the respective reject boxes to a common reject manifold and each of the effluent collectors connects to a common effluent manifold.